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Anomalous B-field Dependence of Spin-flip Time in High Purity InP[1] XIAYU LINPENG, TODD KARIN, University of Washington, RUSSELL BARBOUR, Spectrum Lab, MIKHAIL GLAZOV, Ioffe Institute, KAI-MEI FU, University of Washington — We observe an anomalous B-field dependence of the spin-flip time (T_1) of electrons bound to shallow donors which cannot be explained by current spin-relaxation theories. We conduct resonant pump-probe measurements in high-purity InP from the low to high magnetic field regimes, with a maximum T_1 (400 μs) observed near the turning point $g\mu_B B \simeq k_B T$. At low B, the T_1 dependence on B is consistent with an electron correlation time (τ_c) in the tens of nanoseconds. The physical mechanism for the short τ_c in this high-purity sample ($n \simeq 2 \times 10^{14}$ cm^{-3}) is unclear, but a strong temperature (T) dependence indicates T_1 can be further increased by lowering T below the 1.5 K experimental temperature. At high B, a B^{-3} dependence is observed, in contrast to the expected B^{-5} predicted by single-phonon spin-orbit mediated interactions. An understanding of the anomalous B-field dependence is expected to elucidate the effect of electron transport (low-field) and phonons (high-field) on T_1 for shallow donors, which is of interest for both ensemble and single-spin quantum information applications.

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